



Organic Sponges for Cost Effective CVOC Abatement



Developer: General Electric Corporate R & D Center
Contract Number: DE-AC21-92MC29110
Crosscutting Area: CMST



Problem:

Air emissions of chlorinated volatile organic compounds (CVOCs) are a prime target of the Clean Air Act, and occur at numerous Department of Energy (DOE) sites. Existing methods for reduction of CVOC air emissions have significant shortcomings. Direct incineration of airstreams containing small amounts of CVOCs is technically feasible, but expensive due to the large volumes of air to be treated. Concentration of the CVOCs by carbon adsorption/desorption can be a problem because of low carbon capacity, high carbon regeneration temperatures and loss of carbon during regeneration.

Solution:

Develop recyclable sponges for sorption and recovery of CVOCs. An organic polymer (sponge) is used as a sorbent for concentration of CVOCs from an airstream. To recycle the sponge, it will be desorbed and the concentrated CVOC process stream will be disposed of by biodegradation, reclamation, or incineration.

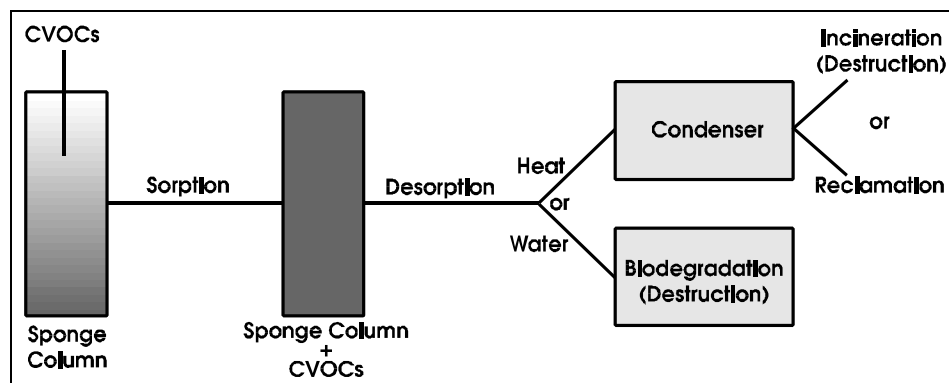
Benefits:

► Higher capacity and selectivity for contaminants

► Easier regeneration of the sorbent bed

► Lower material and system costs

containing CVOCs is directed to the vapor-phase organic sponge system. After passing through the sponge bed, clean air is discharged from the sponge system. The regeneration of



Technology:

This technology employs commercially available and inexpensive polymer sponges to remove CVOC vapors, such as methylene chloride, TCE, PCE, chloroform, and carbon tetrachloride from environmental remediation sites at which CVOCs are volatilized by the nature of the remediation process. Contaminated groundwater is assumed to be available from an existing well system and an equalization tank. The groundwater is pumped from the equalization tank to the top of the air stripper and treated via intimate contact with incoming fresh air in a packed column. The treated water is discharged. The airstream

spent organic sponge is accomplished either thermally or via aqueous desorption and biotreatment. The efficiency of the regeneration process is key to the overall cost effectiveness of this technology.

Aqueous desorption is paired with an onsite biodegradation process for methylene chloride. When coupled to a biodegradation column for methylene chloride destruction, sponge technology offers several important advantages over carbon absorption. Desorption of methylene chloride from the sorption column is affected by an aqueous nutrient solution that is recycled between the sponge column and the bioreactor.



Thermal regeneration generally would not include an onsite destruction process. If the size of the CVOC remediation site is small, then the economics of an on-site destruction process are considerably less attractive. At these smaller scale CVOC remediation sites, thermal regeneration with the collected CVOC being shipped for incineration or reuse may be most cost effective.

Regeneration of the sponge with solvent is not a desirable alternative because of the cost of solvent recovery and other peripheral equipment and the potential for additional environmental emissions. Aqueous desorption and biodegradation or thermal desorption may be cost-effective, depending on the site.

Project Conclusion:

This project was completed in April 1994. Although, this contract was selected for one phase only, there were actually two main thrusts: identification of an effective organic sponge and identification of an effective, continuous biodegradation fluid bed reactor.

Two commercial polymeric sorbents were identified that had significant advantages over the "state of the art" activated carbon sorbent. These advantages were:

- ▶ Similar, although slightly lower capacity
- ▶ Faster sorption
- ▶ CVOC capacity much less affected by relative humidity

- ▶ Much lower sorption of water
- ▶ Greater change in sorption capacity as temperature is increased, making it more thermally desorbable
- ▶ Faster thermal desorption
- ▶ No effect of repeated sorption/desorption on capacity for CVOC
- ▶ Better dynamic performance in a column - quicker restoration of sorption capacity
- ▶ Not catalytic
- ▶ Not friable - low attrition
- ▶ Low fire hazard

The biodegradation of aqueous-phase chlorinated organics in a fluid bed reactor was shown to be commercially viable for methylene chloride using a mixed microbial culture derived from industrial activated sludge. Additionally, the biodegradation of aqueous-phase trichloroethylene in a fluid bed reactor was shown to be promising, but was early in the development stage at contract end.

While there have been several inquiries regarding this technology, there is no known end user at this time.

Contacts:

The General Electric Corporate R & D team has been involved in industrial research since 1920. These efforts have led to the development and commercialization of a wide range of products and

processes. For information on this project, the contractor contact is:

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